

## Science Undergraduate Laboratory Internships (SULI)

Summer 2022 - Application for: Miles Cochran-Branson

### APPLICANT PROFILE

#### General Applicant Information

First Name: Miles

Middle Name:

Last Name: Cochran-Branson

Previous Last Name(s):

Primary Email Address: mcochranbranson@gmail.com

Alternate Email Address 1: cochranm@lawrence.edu

Alternate Email Address 2:

ORCID: [0000-0003-1020-1108](https://orcid.org/0000-0003-1020-1108)

#### Current Address

Primary Phone Number: 916-759-4691

Alternate Phone Number:

#### Citizenship/Languages/Eligibility Information

I will be 18 years of age or older by the time the internship begins: Yes

Are you a U.S. Citizen? Yes

## Science Undergraduate Laboratory Internships (SULI)

Summer 2022 - Application for: Miles Cochran-Branson

### EDUCATIONAL BACKGROUND

#### Academic Information

Are you currently attending a community college or 2-year college?

No

Current academic status:

Junior

If you are selected as a participant in this DOE program, will you receive academic credit from your university/college for participating?

No

#### Undergraduate Institution Information

College/University Country: United States and U.S. Territories

College/University State/Province/Territory:

Wisconsin

College/University Name: Lawrence University

College/University Address: 711 E. John Street

College/University City: Appleton

College/University Zip Code: 54912-0599

Expected/Declared Major:

- Physical Sciences - Physics - Nuclear Physics
- Mathematics

Expected Degree From This College/University:

Bachelor's

Expected/Completed Graduation Date:

June / 2023

Transcript:

miles\_cb\_unofficial\_transcript.pdf

Does this institution provide grades?

Yes

GPA Scale:

4.0

Total Attempted Credits:

152.00

Total Earned Credits:

152.00

Total Quality Points:

608.00

GPA:

4.00

## Science Undergraduate Laboratory Internships (SULI)

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### Science, Technology, Engineering and Mathematics (STEM) Courses

**Course Title:** Advanced Homotopy Continuation

**Course Number:** 599

**Enrollment Status:** Currently Enrolled

**Course Title:** Advanced Laboratory

**Course Number:** 330

**Enrollment Status:** Currently Enrolled

**Course Title:** Computational Algebraic Geometry

**Course Number:** 555

**Enrollment Status:** Recently Completed

**Course Title:** Data scientific programing

**Course Number:** 210

**Enrollment Status:** Recently Completed

**Course Title:** Math Methods of Physics

**Course Number:** 440

**Enrollment Status:** Currently Enrolled

**Course Title:** Quantum Mechanics

**Course Number:** 310

**Enrollment Status:** Recently Completed

**Course Title:** Thermal Physics

**Course Number:** 320

**Enrollment Status:** Planning to Enroll

**Course Title:** Topology

**Course Number:** 560

**Enrollment Status:** Planning to Enroll

## Science Undergraduate Laboratory Internships (SULI)

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### Awards or Honors

**Award Title:** Phi Beta Kappa Downer Freshman Prize for academic excellence during freshman year

**Month & Year Received:** July / 2020

**Awarding Institution:** Lawrence University

**Award Title:** Deans List

**Month & Year Received:** July / 2020

**Awarding Institution:** Lawrence University

**Award Title:** Deans List

**Month & Year Received:** July / 2021

**Awarding Institution:** Lawrence University

**Award Title:** Ralph White Prize for excellence in mathematics

**Month & Year Received:** May / 2021

**Awarding Institution:** Lawrence University

**Award Title:** Sir Issac Newton award for creativity in computational physics

**Month & Year Received:** May / 2021

**Awarding Institution:** Lawrence University

### High School Graduation or GED

**Date of High School Graduation or GED:** June / 2019

**Country:** United States

**City:** Fair Oaks

**State/Province/Territory:** CA

## Science Undergraduate Laboratory Internships (SULI)

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### WORK EXPERIENCE & SKILLS

## Science Undergraduate Laboratory Internships (SULI)

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Work Experience	
<b>Name of Place of Employment or Activity:</b>	University of California, Davis
<b>Dates of Employment or Activity:</b>	From 6/14/2021 To 8/20/2021
<b>Hours Per Week:</b>	50.0
<b>Primary Duties:</b>	Create models using ROOT and/or PYTHIA Read relevant literature Thoroughly document research Participate in weekly group meetings
<b>Tasks Performed:</b>	Code standard relativistic heavy-ion models in order to better understand how quarkonium is produced in PbPb collisions.  Read literature to better understand the physics behind the models I created.  Write an extensive research paper to communicate my research effectively.  Present findings in end-of-program PowerPoint presentation to the UCD physics department  Collaborate with fellow researchers in order to better participate in research being done as part of the UCD nuclear group.
<b>Name of Place of Employment or Activity:</b>	Lawrence University
<b>Dates of Employment or Activity:</b>	From 6/15/2020 To 12/18/2020
<b>Hours Per Week:</b>	40.0
<b>Primary Duties:</b>	Present findings weekly Read relevant materials Create models based in education research Interview students
<b>Tasks Performed:</b>	Create models based on ideas in education research in order to test hypotheses.  Document research and ideas in PowerPoints for weekly presentation and discussion of ideas created.  Read literature on relevant research in physics and psychology.  Conduct interviews based on a complex coding scheme in order to test hypotheses created.  Administer and create basic testing material in order to verify hypotheses.
<b>Name of Place of Employment or Activity:</b>	Lawrence University
<b>Dates of Employment or Activity:</b>	From 1/6/2020 To Present
<b>Hours Per Week:</b>	10.0
<b>Primary Duties:</b>	Peer tutor in physics and mathematics Physics teaching assistant Physics lab assistant Math lab tutor leader
<b>Tasks Performed:</b>	Provide insight in the fundamentals of physics and mathematics to peers in order to supplement retention of information from introductory classes.  Prepare relevant learning materials in order to convey information as accurately and concisely as possible.  Calibrate with fellow tutors / teaching assistants in forming cohesive presentation of information.  Schedule meetings times for tutoring.

## Science Undergraduate Laboratory Internships (SULI)

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<b>Name of Place of Employment or Activity:</b>		RB Consulting
<b>Dates of Employment or Activity:</b>		From 12/2/2019 To 1/3/2020
<b>Hours Per Week:</b>		20.0
<b>Primary Duties:</b>		Data acquisition Data analysis Presentation creation
<b>Tasks Performed:</b>		Retrieve data from published financial reports (e.g. county actuaries) and collect in excel for future data analysis.  Detect trends in data and create meaningful graphics to communicate findings succinctly.  Collect findings in a standard PowerPoint to communicate ideas and findings from analysis.
<b>Professional Associations</b>		
<b>Are you a member of any professional organizations?</b>		Yes
<b>Professional associations you are affiliated with:</b>		American Physical Society (APS)
<b>Computer Skills</b>		
<b>Computer related skills:</b>		I am familiar with the following:  Languages: C++, ROOT, Python, Julia, R  Technology: <i>Mathematica</i> , \LaTeX, Git  I work on a Mac and am thus familiar with Unix, and also have some experience with Linux and bash.
<b>Laboratory/Technical Skills</b>		
<b>Experience with advanced laboratory techniques or equipment:</b>		I have lab experience only through my classes where I have taken an intermediate lab in electronics and will be taking an advanced lab. Over the past summer I worked as part of a relativistic heavy-ion research group where the focus was on data analysis and programming with no physical lab (as the lab for this work is, of course at Brookhaven or CERN). I would love to get more hands on experience though!

## Science Undergraduate Laboratory Internships (SULI)

Summer 2022 - Application for: Miles Cochran-Branson

### PROGRAM INFORMATION

#### Eligibility

Have you previously participated in 2  
SULI appointments? No

#### Previous DOE Internship/Fellowship or Lab Activity Experience

Have you ever had an  
internship/fellowship with the  
Department of Energy or any of its  
National Laboratories (such as SULI,  
CCI, VFP) or attended an activity at  
one of the National Laboratories  
(such as a Mini-Semester or  
Sustainable Research Pathways)? No

#### Availability

What is the earliest date you can  
begin your internship? 6/14/2022

When do you need to complete your  
internship? 9/2/2022

#### First Choice Host DOE Laboratory

DOE Laboratory: Thomas Jefferson National Accelerator Facility (TJNAF)

First Choice Research Area: Nuclear Physics

Second Choice Research Area: Accelerator Physics/Science

Third Choice Research Area: High Energy Physics

#### Second Choice Host DOE Laboratory

DOE Laboratory: Brookhaven National Laboratory (BNL)

First Choice Research Area: Nuclear Physics

Second Choice Research Area: Accelerator Physics/Science

Third Choice Research Area: High Energy Physics

#### Relatives Employed at DOE Laboratories

Are you a relative of an employee at  
the proposed host DOE laboratories? No



## Science Undergraduate Laboratory Internships (SULI)

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### ESSAYS

#### Research Experience:

My first research experience was in physics education (PER) at Lawrence University. Under the direction of Tianlong Zu, I designed a model to help improve introductory students' retention of new information specifically related to drawing free-body diagrams—a fundamental aspect of Newtonian mechanics. My research culminated in testing my model through interviews and short quizzes of students. To do this, I created a coding model for student responses and for analyzing tests. With the small dataset I had, I found many of the hypotheses I formed were correct while some required slight modification. I was later invited to be a teaching assistant for the introductory physics classes and was thus able to see some of the ideas Zu and I discussed implemented in class. This project was incredibly independent as I was the only student working on it. The project provided an excellent introduction to research in physics and sparked an interest in physics outside of education research.

In my second research experience, I worked with Manuel Calderón de la Barca Sánchez at UC Davis studying relativistic heavy ion physics. This research was conducted as part of the CMS collaboration at CERN, which studies the collisions of heavy ions (nuclei). I was working on a project analyzing the uncorrelated double production of quarkonium (heavy mesons, i.e., quark-antiquark hadrons) in PbPb collisions. In order to do data analysis and make effective conclusions, we needed a model-dependent estimate for production. I created an estimate for this production mechanism using a Monte-Carlo Glauber model and a Monte-Carlo particle production simulation (PYTHIA). While my research was part of a much larger project, I enjoyed a significant amount of independence in researching and implementing the necessary models to properly estimate production. The estimates I derived are being used currently in data analysis at UC Davis.

Through both projects I strengthened my ability to read and derive conclusions from scientific writing; I also learned how to make testable hypotheses and execute a plan to test my hypotheses. Additionally, I learned how to use data analysis tools, specifically CERN's ROOT library and C++ programming, as well as advanced C++ workflow such as building and including external simulations in my own code. These skills will be invaluable as I continue my research career.

#### Research Interests:

Over the past year I have become increasingly interested in research at both Jefferson and Brookhaven Labs. I am primarily interested in nuclear physics from the perspective of fundamental research. I have, for instance, extensively read about the proton radius puzzle for which the PRad experiment at Jefferson has been key. Experiments which explore the fundamental nature of the universe, such as the building blocks of the proton, excite me. Techniques of electron scattering are new to me, but I find the underlying physics incredibly stimulating and would like to gain experience in the techniques used at Jefferson. Having worked in heavy ion experiments, I have also read many papers about Brookhaven's collider and the physics that has come out of it. I am very interested in probing and understanding the quark-gluon-plasma, for instance, and RHIC at Brookhaven would be a perfect place to explore this further. Moreover, the new plans to change RHIC into an electron-ion collider and the potential new physics to come out of this I find very interesting. Getting exposure to this project in its early stage would help me see how this new collider will shape how heavy-ion physics might look. In both labs, I am looking to explore the computational / experimental side of physics with both theoretical and data-analysis components. I would also like to have hands-on experience of the experiments I have been reading about and see how physical research is being done.

Jefferson is my first choice as I would like to explore slightly lower-energy nuclear physics. While I find high-energy extremely fascinating, I would like to broaden my experience outside of this field and see what other physics there is. Experiments that I have been following include the PRad experiment, as well as experiments on the origin of the proton's mass and the composition of the pion. I am very interested in exploring fundamental physics, specifically strong force interactions. This, of course, includes high energy nuclear and accelerator physics which I would also like to learn more about.

I am very excited to potentially be a part of the international community of research that starts at the national labs. I believe that exposure to the research occurring at either Jefferson or Brookhaven will prepare me for a future career in research.

## Science Undergraduate Laboratory Internships (SULI)

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**Personal Experience:**

My education through Lawrence University, and my research experiences at Lawrence and UC Davis, have prepared me to be a valuable participant in a SULI program. Lawrence is a small school, with an 8:1 student to faculty ratio. This allows me to have in-depth engagement with my physics and mathematics professors and to participate one-on-one in their ongoing research and projects. In my first research experience at Lawrence, I worked closely with a professor studying and developing testable hypotheses in physics education. I presented my independent research weekly to my professor and developed the framework for potential future publication. This experience confirmed my interest in pursuing research in fundamental physics and led to my second major research experience at the University of California, Davis (UCD) in which I explored aspects of strong force interactions through high-energy collisions of nuclei. My write-up of the UCD research was accepted for presentation at the 2021 conference of the American Physical Society's Division of Nuclear Physics (DNP) international annual meeting.

In addition to prescribed course work, I have arranged several one-on-one independent studies, such as my upcoming course on computational methods of mathematics. Specifically, I will be exploring Homotopy Continuation and other methods from algebraic geometry to numerically solve systems of polynomial equations; this is a continuation of a mathematics course I have already taken. This material is directly applicable to the research I will continue to do in physics, as polynomial equations are ubiquitous in physics and the sciences.

Finally, I have several jobs as both a physics and mathematics tutor, as well as a classroom teaching assistant for physics, that aid in developing science communication skills. I act both as a one-on-one tutor for students in introductory courses at Lawrence, as well as lead group tutoring sections in mathematics weekly. As a teaching assistant, I am required to rearticulate concepts in the introductory physics courses to help students understand fundamental principles. All of this experience has made me into an articulate and concise communicator of physics and mathematics, and has provided invaluable experience in developing critical research skills. These skills include effective communication and a deep understanding of the fundamentals of physics that allow me to quickly understand more complex topics.

**Professional Goals:**

I plan on pursuing a Ph.D. in fundamental physics, most likely in nuclear physics, with the goal of pursuing research professionally either at a national lab or a research university. I find systematically solving small problems to understand a larger whole incredibly satisfying. This desire to understand the world through incremental progress led me to pursue opportunities in physics research resulting in two extensive research projects, as well as challenging course material in both physics and mathematics at Lawrence University.

An internship as part of the SULI program would be a natural next step in my young research career. It would provide additional research experience in areas that I am currently interested in and give some insight into how research is conducted at national labs. Additionally, an internship in nuclear physics would help develop my research skills both in the lab and computationally. Having learned how to competently use ROOT last summer, strengthening these skills through research would be invaluable. Finally, developing some hands-on research skills would help strengthen physical concepts to research which I have, until now, only read about. Being a SULI program member would be an incredibly valuable experience which would propel my professional and academic career through strengthening relevant research skills.

## Science Undergraduate Laboratory Internships (SULI)

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### RECOMMENDATIONS

**Recommendation 1:** **First Name:** Manuel  
**Last Name:** Calderon  
**Email:** mcalderon@ucdavis.edu  
**Status:** Received 1/12/2022

**Recommendation 2:** **First Name:** Tianlong  
**Last Name:** Zu  
**Email:** tzu@jsu.edu  
**Status:** Received 1/6/2022

# View Your Program Information & Academic History

This is NOT an official transcript.

CAUTION: During end-of-term grade processing (last day of classes through the first week of the term break) the information displayed may be incomplete and inaccurate.

## Lawrence University Academic Program Information for Miles Gerrit Cochran-Branson as of December 18, 2021

<b>Program:</b> B.A. Degree Program	<b>Class Standing:</b> Junior
<b>Major(s):</b> Mathematics, Physics	<b>Current Academic Standing:</b> Good Standing as of Fall Term 2021
<b>Minor(s):</b>	<b>Degree Status:</b>
<b>Conc(s):</b>	<b>Graduation Status:</b>
<b>Advisor(s):</b> S. Corry, A. Guenther-Pal, M. Pickett	

### Lawrence Work

Term	CRN	Subj	#	Title	Grade	Attmp Units	Earned Units	GPA Units	Qty Pts	Comp	Instrs
Fall Term 2019	5989	FRST	100	FRESHMAN STUDIES	A	6	6	6	24.00		Andrew J. Sage
Fall Term 2019	5351	MATH	140	CALCULUS I	A	6	6	6	24.00	Q	Alan Parks
Fall Term 2019	6177	MUEN	245	CHAMBER MUSIC	A	1	1	1	4.00		Wen-Lei Gu
Fall Term 2019	5520	MUIN	304	VIOLIN	A	3	3	3	12.00		Wen-Lei Gu
Fall Term 2019	5563	PHYS	141	PRINCIPLES OF MECHANICS	A	6	6	6	24.00	Q	Megan Pickett, Jeffrey A. Collett
Winter Term 2020	2016	FRST	101	FRESHMAN STUDIES	A	6	6	6	24.00		Ruth M. Lunt
Winter Term 2020	1361	MATH	155	MULTIVARIABLE CALCULUS	A	6	6	6	24.00	Q	Alan Parks
Winter Term 2020	2206	MUEN	245	CHAMBER MUSIC	A	1	1	1	4.00		Wen-Lei Gu
Winter Term 2020	1527	MUIN	304	VIOLIN	A	3	3	3	12.00		Wen-Lei Gu
Winter Term 2020	2152	MUIN	399	IS-BACH CHACONNE STUDY	A	1	1	1	4.00		Wen-Lei Gu
Winter Term 2020	1570	PHYS	151	PRINCIPLES CLASSICAL PHYSICS	A	6	6	6	24.00	Q	Douglas S. Martin, Margaret Koker, Tianlong Zu
Spring	3273	GER	312	READING TEXTS	A	6	6	6	24.00	AM	Alison C.

Term 2020		AND CONTEXTS							Guenther-Pal	
Spring Term 2020	3367 MATH 200	COMPLEX SEQUENCES AND SERIES	A	6	6	6	24.00	Q	Scott Corry	
Spring Term 2020	3546 MUIN 304	VIOLIN	A	3	3	3	12.00		Wen-Lei Gu	
Spring Term 2020	4041 MUIN 399	IS-BEETHOVEN SONATA NO7 STUDY	A	1	1	1	4.00		Wen-Lei Gu	
Spring Term 2020	3588 PHYS 160	PRINCIPLES OF MODERN PHYSICS	A	6	6	6	24.00	Q	Jeffrey A. Collett, Tianlong Zu	
Fall Term 2020	5013 MATH 210	DIFF EQUATIONS W/LINEAR ALG	A	6	6	6	24.00	Q	Scott Corry	
Fall Term 2020	6198 MUEN 440	ADVANCED CHAMBER MUS STUDIES A	A	1	1	1	4.00		Matthew C. Michelic	
Fall Term 2020	5866 MUIN 304	VIOLIN	A	6	6	6	24.00		Wen-Lei Gu	
Fall Term 2020	5116 PHYS 220	INTERMEDIATE LAB: ELECTRONICS	A	6	6	6	24.00	Q	Margaret Koker	
Fall Term 2020	6051 PHYS 399	IS-STUDY IN PER	A	2	2	2	8.00		Tianlong Zu	
Winter Term 2021	1903 MATH 230	DISCRETE MATHEMATICS	A	6	6	6	24.00	Q	Elizabeth K. Sattler	
Winter Term 2021	2287 MUEN 245	CHAMBER MUSIC 3	A	1	1	1	4.00		Anthony P. Padilla	
Winter Term 2021	1867 MUIN 304	VIOLIN	A	3	3	3	12.00		Wen-Lei Gu	
Winter Term 2021	2221 MUIN 399	IS-STUDY OF TCHAIKOV CONCERTO	A	1	1	1	4.00		Wen-Lei Gu	
Winter Term 2021	1118 PHYS 225	COMPUTATIONAL MECHANICS	A	6	6	6	24.00	Q	Megan Pickett	
Winter Term 2021	1183 PSYC 230	PSYCHOLOGY OF MUSIC	A	6	6	6	24.00		Terry L. Gottfried	
Spring Term 2021	3170 GER 417	DEUTSCHE? DEMOKRATI? REPUBLIK?	A	6	6	6	24.00		Vanessa D. Plumly	
Spring Term 2021	3917 MATH 250	LINEAR ALGEBRA	A	6	6	6	24.00		Alan Parks	
Spring Term 2021	4329 MUEN 245	CHAMBER MUSIC 1	A	1	1	1	4.00		Anthony P. Padilla	
Spring Term 2021	3884 MUIN 304	VIOLIN	A	3	3	3	12.00		Wen-Lei Gu	
Spring Term 2021	4222 MUIN 399	IS-TCHAIK CONCERTO STUDY	A	1	1	1	4.00		Wen-Lei Gu	
Spring Term 2021	3148 PHYS 230	ELECTRICITY AND MAGNETISM	A	6	6	6	24.00	Q	Tianlong Zu	
Fall Term	5041 CMSC 205	DATA-SCIENTIFIC	A	6	6	6	24.00	Q	Abhishek	

2021			PROGRAMMING							Chakraborty
Fall Term 2021	5337 MATH	555	TOP: COMPUTATIONAL ALG. GEOM.	A	6	6	6	24.00		Alexander Michael Heaton
Fall Term 2021	5484 PHYS	310	QUANTUM MECHANICS	A	6	6	6	24.00	Q	Jeffrey A. Collett
Totals (Undergraduate)										

	Attmpt Units	Earned Units	GPA Units	Qty Pts	GPA	
Cumulative Degree	152	152	152	608.00	4.000	
Cumulative Composite			152	608.00	4.000	

#### Courses in Progress

Term	CRN	Subj	#	Title	Attmpt Units	Comp	Instrs
Winter Term 2022	1321	ETST	301	THEORIES OF RACE AND ETHNICITY	6	DW	Jesus G. Smith
Winter Term 2022	1517	PHYS	330	ADVANCED LABORATORY	6	SQ	Margaret Koker, Matthew R. Stoneking
Winter Term 2022	1518	PHYS	440	MATHEMATICAL METHDS OF PHYSICS	6		Megan Pickett
Spring Term 2022	3161	MATH	560	TOPOLOGY	6		Elizabeth K. Sattler
Spring Term 2022	3461	PHYS	320	THERMAL PHYSICS	6	Q	Douglas S. Martin
Spring Term 2022	3088	RLST	228	YOGA: THEORY AND PRACTICE	6	G	Constance Kassor

# SULI PROGRAM APPLICATION RECOMMENDATION FOR MILES COCHRAN-BRANSON

## Recommender Contact Information

- **First Name:** Tianlong
- **Last Name:** Zu
- **Title:** Dr.
- **Department:** Department of Chemistry and Geosciences
- **Institution/Organization:** Jacksonville State University
- **Telephone:**
- **Email:** tzu@jsu.edu

## Applicant Information

### Association

Describe your relationship to the applicant, including how long you've known the applicant, where, and in what capacity.

I have known Mr. Miles Cochran-Branson when I was a visiting assistant professor at Lawrence University since 2019-2021. Mr. Cochran-Branson work on a summer research project with me during the year 2020. He continued on the project in Fall 2020. We have weekly meetings discussing his progress on the project. Under my supervision, Mr. Cochran-Branson has learnt quickly and steadily a number of research skills including but not limited to 1) conducting qualitative and quantitative interviews with students in one on one settings, 2) how to conduct code analysis, 3) conduct a through literature rereview in the relevant field - physics education research. Additinally, Mr. Cochran-Branson has taken multiple undergraduate courses with me during this period. He also worked as a undergraduate TA for two of the introductory courses I taught at Lawrence. He has been a straight A students in all the course I taught and all other courses he has taken.

## Applicant Comments

Please provide substantive comments about the applicant's education, training, aptitude, or promise relevant to the SULI program. Include any relevant additional detail or perspective regarding the applicant's research experience or equivalent experience on complex projects, including the level of independence or other factors that would contribute to the applicant's ability to make an excellent contribution to the SULI program.

Dear Committee Members:

My name is Tianlong Zu, currently an Assistant Professor at Jacksonville State University. In this letter, I would like to strongly recommend Mr. Miles Cochran-Branson to be selected by the Science Undergraduate Laboratory Internships program.

Below are my reasons for why I believe Mr. Miles Cochran-Branson will be successful in the STEM field in the future. First of all, Mr. Cochran-Branson has been doing fantastically in two of the courses (Intro Physics and Intermediate level Electricity and Magnetism) I taught when I was a visiting scholar at Lawrence University. He was definitely a leader in both classes. He asks challenging

questions and shows strong interests in pursuing answers outside the classroom. He would talk to me about them quite often. It was through these informal conversations, I have learnt his strong interest in physics education as well as a career for being experimental nuclear physicists who would work in a national lab.

Mr. Cochran-Branson later did one research projects with me in the fall of 2020 titled “how introductory students modify their incorrect answers chronically in a semester”. In this project, Mr. Cochran-Branson, under my guidance, could pick up literature reading quite quickly and later conducted tens of individual interviews as part of the research projects. In this project, he learned how to conduct code analysis, how to make good PPT presentations, how to present results to a large group of audience. Through this project, I can see he has strong potential to conduct research and be successful in graduate school and a career in science.

Besides his strong intellectual potential for physics research, he also has excellent personality. He copes well with his peers. From that, I see he will do very well as part of a research team in the future. That will make him go way further in addition to his straight A performance academically.

As such, I strongly recommend Mr. Cochran-Branson to be selected by the Science Undergraduate Laboratory Internships program. He has great talent and wonderful personality to be a leader in science field. If there are any more questions. Please send emails to [tzu@jsu.edu](mailto:tzu@jsu.edu). I will be more than happy to chat about his other talents and potentials.

Best,

Tianlong Zu, Ph. D. in Physics

Jacksonville State University



## Applicant Rating

In comparison to other undergraduate students, please rate the applicant relative to his/her peers on the following qualifications:

	Do Not Know	Below Average	Average	Above Average	Superior
Analytical and Mathematical					X
Experimental Research					X
Overall Academic				X	
Initiative and Self Reliance					X
Motivation toward Scientific Career					X
Originality of Thought				X	
Emotional Maturity					X
Ability to Work with Others					X
Potential for Leadership				X	
Oral Communication Skills				X	
Written Communication Skills				X	

# SULI PROGRAM APPLICATION RECOMMENDATION FOR MILES COCHRAN-BRANSON

## Recommender Contact Information

- **First Name:** Manuel
- **Last Name:** Calderon de la Barca
- **Title:** Professor
- **Department:** Physics
- **Institution/Organization:** UC Davis
- **Telephone:**
- **Email:** mcalderson@ucdavis.edu

## Applicant Information

### Association

Describe your relationship to the applicant, including how long you've known the applicant, where, and in what capacity.

Miles Cochran-Branson's was a summer NSF REU student at UC Davis in the summer of 2021, where he worked with my research group on relativistic heavy-ion collisions. I therefore had a good opportunity to work closely with him as his summer research advisor.

### Applicant Comments

Please provide substantive comments about the applicant's education, training, aptitude, or promise relevant to the SULI program. Include any relevant additional detail or perspective regarding the applicant's research experience or equivalent experience on complex projects, including the level of independence or other factors that would contribute to the applicant's ability to make an excellent contribution to the SULI program.

I am strongly support Miles's application to SULI. He did excellent work as an REU student, and he is very motivated to continue working in nuclear physics. Let me discuss my experience. Miles's project involved writing code for a Monte Carlo Glauber model of a heavy ion collision. During this period, he had to learn C++ and the ROOT analysis package that is used in high-energy physics by e.g. experiments at RHIC and at the LHC.

At the beginning of the REU period, I run a two week crash course with the summer undergraduates doing research in my group, not just from the REU program but also UCD undergraduates. Miles was clearly one of the most talented students of his cohort. For example, it usually takes a few weeks for students to be able to code their own fitting algorithm in order to compare the results of their Monte Carlo simulation to data. There are routines available to do this when a calculation can be done analytically, but it is not straightforward to do when the calculation is done via a Monte Carlo simulation due to the inherent presence of fluctuations in the calculation. Miles was one of the students who was able to complete this part in record time, and who immediately wanted to figure out how to automate his programs to deal with the difficulties of the fluctuations, something that is not trivial to do. Having mastered this part of the project extremely quickly, the main part of his summer project began. It involved simulating the occurrence of a rare process within the collision, in Miles's case the rare process was the production of a heavy quark-antiquark pairs, called 'quarkonium'. In order to keep things simple, we simply used probabilities to decide when such a process might occur. The main part of the project was to investigate how often such a process occurs in a heavy-ion collision if one models it as a superposition of simpler nucleon-nucleon collisions.

The question that we wanted to investigate was how often would we see two independent quarkonium processes. This required Miles to learn about the different kinds of quarkonium processes, how their probabilities depend on the energy of the collision, and to start first with single-quarkonium calculations to then proceed to the double-quarkonium calculation.

Most summer students would have only just been able to finish such a project. However, Miles finished with ample time to take it further. In order to make the calculation useful as a way to estimate what might be seen in an experiment, such as in the Compact Muon Solenoid (CMS) experiment,

it is not sufficient to just estimate the probabilities of production. It is necessary to also model the kinematical properties of the particles and of their decays. In order to do this, there are event generators that can encode the Physics and can be used for this. Miles learned how to use the event generator named Pythia, which is commonly used in high-energy physics, in order to be able to estimate the fraction of quarkonium particles that could be detected by the experiment. What is noteworthy about this is that summer students typically have enough time to work on a model such as the Glauber Model, or they have time to learn and use an event generator like Pythia. Miles did both. This indicates that Miles is clearly among the brightest students and was able to absorb the techniques and the language of high-energy nuclear physics extremely quickly.

He obtained predictions for what we might observe in CMS, which will be used to compare to the measurements obtained by a graduate students in my group. These predictions were purely the work of Miles, and he clearly understood the importance of his work and how it fit with the work that was being carried out in my group. Miles was also very proactive in finding opportunities for career growth. When we discussed the idea of participating in the Conference Experience for Undergraduates at the Division of Nuclear Physics meeting this fall, Miles jumped at the opportunity to participate. He prepared a poster and followed up on this, even after leaving UC Davis and returning to his college. Sometimes, as students return to their home institute and classes take over, it is not so easy for them to stay engaged with their summer project. Miles was clearly not one of these cases, showing diligence and persistence in completing projects and the strong desire to showcase his work to make the best of his summer research opportunity.

He made clear his interest in a scientific career. Given his talent and drive, I am confident that he will be a mover-and-shaker in any field he chooses.

For all these reasons, I very strongly support his application.

## Applicant Rating

In comparison to other undergraduate students, please rate the applicant relative to his/her peers on the following qualifications:

	Do Not Know	Below Average	Average	Above Average	Superior
<b>Analytical and Mathematical</b>				X	
<b>Experimental Research</b>					X
<b>Overall Academic</b>					X
<b>Initiative and Self Reliance</b>					X
<b>Motivation toward Scientific Career</b>					X
<b>Originality of Thought</b>				X	
<b>Emotional Maturity</b>					X
<b>Ability to Work with Others</b>					X
<b>Potential for Leadership</b>					X
<b>Oral Communication Skills</b>					X
<b>Written Communication Skills</b>					X